MULTIMEDIA UNIVERSITY ™

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

TRIMESTER 2 , **SESSION 2022 / 2023**

## EEL2026 – POWER TRANSMISSION AND DISTRIBUTION

(LE)

14 JULY 2023
09.00 AM – 11.00 AM
(2 Hours)

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**INSTRUCTIONS TO STUDENT**

1. This question paper consists of 4 pages including the cover page with 4 Questions only.

2. Attempt all questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

## Question 1

(a) State **THREE** advantages and **THREE** disadvantages of High Voltage Direct Current transmission systems. [9 marks]

(b) A three-phase transmission line is designed to deliver 350 MVA at 420 kV over a distance of 100 km. The total transmission line loss is not to exceed 2 percent of the rated line MVA at 75°C conductor temperature. If the resistivity of the stranded aluminum conductor, $\rho$ is $3.47\times10^{-8}$ Ω-m, determine the required conductor diameter. [8 marks]

(c) The conductor of a single-phase 50-Hz line is a solid round aluminum wire having a diameter of 0.5 cm. The conductor spacing is 4.0 m. Determine the inductance of the line in mH per km. How much inductance is due to internal flux linkage? Neglect skin effect. What is the effect of the spacing between the conductors on the inductance of the line? [7 marks]

(d) A completely transposed three-phase 50-Hz line has triangular conductor configuration. Given $D_{12}$ = 4 m, $D_{23}$ = 6 m, $D_{31}$ = 7 m and the radius of each conductor is 0.3175 cm. Determine the line to neutral inductance and associated reactance. What is the necessity of transposition of conductors on tower? [9 marks]

(e) Calculate the capacitive reactance in ohm-kilometers of a 50-Hz three-phase line having horizontal disposition of conductors. The outer radius of the conductor is 2.0 cm. The spacing between the conductors is 15, 15 and 30 m. [7 marks]

## Question 2

A 275-kV, three phase, 50-Hz transmission line, the resistance per phase is 0.15 Ω per km and the inductance per phase is 1.5 mH per km. When the line supplying a three-phase load of 476 MVA at 0.8 power factor, obtain the voltage and power at the sending end, the voltage regulation and efficiency of a three-phase for a:

(a) 60 km long transmission line [7 marks]

(b) 160 km long transmission line when the total shunt susceptance per phase is $0.583\text{x}10^{-3}$ S. [Hint: Use the medium line π-model] [13 marks]

Note: You will need to show the calculation in full detail instead of just giving the final answer.

**Continued...**

## Question 3

(a) The suspension type insulators are preferred in transmission line with voltage level above 66 kV. List out **THREE** reasons why this type of insulators is preferred. [6 marks]

(b) Figure 3(b) shows a string of five insulators where the disc string capacitance between each unit and earth is 1/8 of the mutual capacitance.
[Hint: *m* is equivalent to 8]

(i) Calculate the voltage distribution across each insulator in the string as percentage of voltage of the conductor to earth. [5 marks]

(ii) Calculate the string efficiency. [2 marks]

(iii) How is this efficiency affected by rain? [2 marks]

(iv) If this string of five insulators is to be graded to obtain uniform distribution of voltages across the string, find the capacitances of each unit. [5 marks]

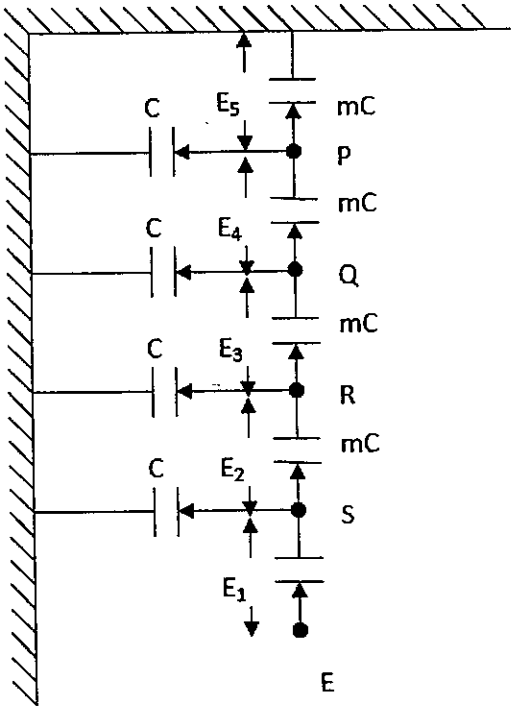


Figure 3(b)

**Continued...**

## Question 4

(a) List out **THREE** factors affecting the selection of the rating of a primary feeder. [3 marks]

(b) A single-phase AC distributor fed at end A is loaded as shown in Figure 4(b). The loop resistance and reactance per km are 0.3 Ω and 0.2 Ω respectively. Determine the voltage drop in the distributor and voltage at the far end if Vs is $240\angle 0^{o}$ V. You can use either exact or approximate methods. [9 marks]

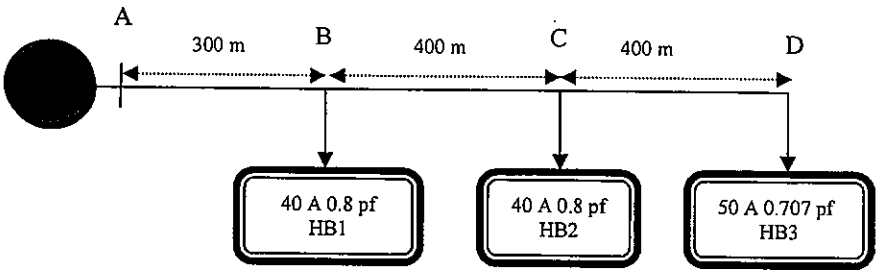


Figure 4(b)

(c) A 22-kV voltage is applied to a three-phase distributor having R = 6 Ω and X = 8 Ω per phase. At the end of the line is a balanced load of *P* MW at 0.6 power factor leading. At what value of P is the load voltage being equal to supply voltage?
[Hint: Use $V_S^2 = V_R^2 + I^2 (R^2 + X^2) + 2V_R I R \cos \varphi - 2V_R X I \sin \varphi$ for a distribution line] [8 marks]

**End of Paper**